Findings of the Scientific Review Panel on
THE REPORT ON FORMALDEHYDE
As Adopted at the Panel's December 5, 1991 Meeting

In accordance with the provisions of Health and Safety Code Section 39661, the Scientific Review Panel (SRP) has reviewed the report ("Proposed Identification of Formaldehyde as a Toxic Air Contaminant") of the staffs of the Air Resources Board (ARB) and the Office of Environmental Health Hazard Assessment (OEHHA) on the public exposure to, and health effects of formaldehyde. The Panel also reviewed the public comments received on this report. Based on this review, the SRP finds that the report on formaldehyde is without serious deficiencies and agrees with the staffs of the ARB and OEHHA that:

1. There is evidence that exposure to formaldehyde results in animal carcinogenicity and probable human carcinogenicity. Both the International Agency for Research on Cancer (IARC) and the United States Environmental Protection Agency (EPA) have classified formaldehyde as a probable human carcinogen, on the basis of sufficient evidence for carcinogenicity in animals and limited evidence in humans.

2. Because formaldehyde is listed as a hazardous air pollutant under Section 112 of the United States Clean Air Act of 1990, identification

of formaldehyde as a toxic air contaminant is required by the California Health and Safety Code Section 39655.

3. Based on available scientific information, a level of formaldehyde exposure below which no carcinogenic effects are anticipated cannot be identified.

4. Based on a health protective interpretation of available scientific evidence, the upper 95 percent confidence limits on the lifetime risk of cancer from formaldehyde range at ambient concentrations from 0.3 to 40 $\times 10^{-6}$ ppbv^{-1} [0.25 to 33 $\times 10^{-6}$ (ug/m^3)$^{-1}$]. Furthermore, 7 X 10^{-6} ppbv^{-1} [6 x 10^{-6} (ug/m^3)$^{-1}$] is the best value of the upper confidence limit of risk. Appendix I compares the best value of upper-bound formaldehyde cancer unit risk with those of other compounds reviewed by the SRP (the dates these compounds' identification reports were approved by the SRP are included in Appendix I). These 95 percent upper confidence limits for excess lifetime risks are health-protective estimates; the actual risk may be significantly lower.

5. The major identified sources of outdoor ambient formaldehyde are direct emissions from mobile sources and oil refineries and secondary formation by photochemical reactions.

6. Based on data collected by the ARB's ambient toxic air contaminant monitoring network, the estimated mean annual population-weighted outdoor ambient exposure for approximately 20 million Californians is 4.4 ppbv.

7. Based on the ARB emission inventory, areas that are expected to have formaldehyde levels higher than the mean statewide concentration are near commercial production sources, reconstituted wood processing plants, oil refineries, and in urban areas congested freeways. However, the emission inventory is incomplete and a number of potential hot spots have not yet been adequately evaluated.

8. Based on its gas-phase reactivity from photolysis and oxidation by the hydroxyl radical, formaldehyde's estimated tropospheric lifetime is approximately 0.3 days.

9. Results from indoor monitoring in California's conventional and mobile homes, offices, and public buildings indicate that people are exposed frequently to much higher indoor concentrations than outdoor formaldehyde concentrations due to the abundance of building materials and other domestic products in buildings that emit formaldehyde. The results of recent surveys indicate that formaldehyde concentrations

inside California residences generally range from less than 10 ppbv to 500 ppbv. Mean concentrations can range from 24 ppbv in office and public buildings to 72 ppbv for mobile homes, with a mean concentration of 50 ppbv found in conventional homes.

10. A number of adverse health effects have been associated with formaldehyde exposure. Acute effects include irritation of the skin, eyes and mucous membranes, as well as causing nausea and headaches. Skin contact with formaldehyde can induce long-term allergic dermal sensitization, and limited evidence suggests that inhalation of high concentrations of formaldehyde can cause respiratory tract sensitization. Adverse health effects other than cancer are not expected to occur at mean statewide outdoor ambient concentrations. However, there is sufficient evidence that adverse acute health effects may result from exposure to levels found in indoor environments for those sensitive to formaldehyde.

11. Based on the OEHHA staff's best value for cancer unit risk of 7×10^{-6} ppbv^{-1} and the ARB staff's population-weighted outdoor ambient exposure of 4.4 ppbv, up to 31 potential excess cancers per million are predicted if exposed to this level over a 70 year lifetime. In addition, the staff's of ARB and OEHHA have developed cancer risk based on relative exposure to indoor and outdoor concentrations. Using the OEHHA staff's best value for cancer unit risk of 7×10^{-6} ppbv^{-1} and the corresponding concentrations found in indoor and outdoor environments, the number of excess cancer cases due to indoor and outdoor exposure to formaldehyde is estimated to be 230 and 5 per million, respectively, for a 70 year lifetime. This corresponds to an excess cancer burden of 7,000 and 150 for indoor and outdoor exposures, respectively, for a California population of 30 million.

12. Based on available scientific evidence indicating that formaldehyde is an animal and a probable human carcinogen, we conclude that formaldehyde should be identified as a toxic air contaminant.

For these reasons, we agree with the ARB staff recommendation to its Board that formaldehyde be listed by the ARB as a toxic air contaminant.

I certify that the above is a true and correct copy of the findings adopted by the Scientific Review Panel on December 5, 1991

Dr. James H. Pitts, Jr.
Chairman, SRP